IMPROVED HOT WEATHER CAULIFLOWER TYPES

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Cauliflower is considered a cool weather vegetable and is not generally recommended for low elevations in Hawaii. The Snowball varieties of cauliflower, which are the principal commercial types grown on the United States mainland, are better adapted to the high-elevation farming areas here. The need for an improved hot weather cauliflower variety well-adapted to lower elevations (below 800 feet) has led to a program of selection and improvement in this crop by the Hawaii Agricultural Experiment Station since early in 1949. Several breeding lines have been developed and one of them has been named Pua Kea. Seed samples of this variety and related lines are now available to interested growers. The 12 cauliflower plantings carried out at the HAES between 1949 and 1953 have included several cultural studies in addition to the breeding plots. This circular describes the hot weather cauliflower now available at the HAES and summarizes information gained on cultural problems.

PARENTAGE AND DEVELOPMENT OF HOT WEATHER CAULIFLOWER LINES

The hot weather cauliflower lines included in the cauliflower improvement work at the University of Hawaii were derived from selections made in an initial observation planting of 28 varieties. Most of these varieties were Indian types. A wide range of horticultural defects was exhibited by these plants, particularly in respect to riciness, colored florets, leaves growing in the curd, poor or variable yield, and irregular maturity.

Only one line of Indian cauliflower in this planting showed much horticultural promise. Selections were made, therefore, in this group of plants. Although superior to other lines observed, this group was quite variable in yield, time of maturity, and curd color and showed some leafiness in the curd, riciness, and some colored florets. There was also wide variation in plant habit, most plants failing to show upright wrapper leaves around the curd. Selections made in this line (Early Market 3808-G) were isolated with cheesecloth hoods. To prevent cross pollination, this was done before the flowers opened. Bees were liberated under these hoods to pollinate the flowers of each individual plant selected. Self-pollinated seed was thus obtained from 19 plants.

Continued selection in these inbred lines was undertaken with the object of eliminating undesirable characters in the shortest time possible. Although self-pollination in the cauliflower lines permits a more efficient selection against horticultural defects, some reduction in vigor is expected in most of the inbred plants. This vigor can be restored by open pollination in seed-increase plots. The seed samples distributed to growers at the Experiment Station are, therefore, from open-pollinated, selected plants.

DESCRIPTION OF HOT WEATHER CAULIFLOWER TYPES

Some of the distinctive horticultural characters which can be observed in hot weather cauliflower lines now included in the HAES cauliflower selection program are as follows:

Time of Maturity. Eighty to 90 days from seed, with some variation among individual plants as well as variation according to growing conditions, season, etc. This is much earlier than the earliest of the standard Snowball varieties.

Curd Color and Quality. When the cauliflower curds are exposed to direct sunlight, a color develops which varies from a very light cream to a stronger yellow tint. Shading of the curd by upright wrapper leaves reduces this color and leaves a whiter curd, but distinct heritable differences exist among these plants in the depth of the creamy-yellow color which develops upon exposure to sunlight. Both very light cream and darker yellow selections are available. Market preference is ordinarily for the light-colored curds. The stronger yellow-cream color has been retained in a few selections because of the possibility of greater nutritional values in this product, even though it is not popular at the present time. Purple-colored florets have been largely eliminated from the HAES breeding lines, although an occasional plant shows a very faint pinkish tint in the florets. This is rarely strong enough to mar the appearance of the curd. In Hawaii, the standard mainland cauliflower varieties usually develop an extensive purple coloring of the florets when the curd is exposed to the sun at low elevations. This product is not only unmarketable in appearance, but when it is grown in hot weather the curd quality is poor, if the plants produce anything at all.

Response to Hot Weather. The improved hot weather lines do not become tough or unproductive, even under midsummer conditions at low elevations. Reports received on the eating qualities of these lines have been highly favorable. However, the cauliflower should not be overcooked. Three or four minutes in boiling water is sufficient. The curds are tender enough to be eaten uncooked. Harvesting the hot weather cauliflower at the right time is important in preserving curd quality.

Size of Curds. Although they will produce good-quality cauliflower under conditions which are too warm for the Snowball varieties, the Indian or hot weather lines usually yield curds of lighter weight than do the Snowball types when these are grown under conditions favorable to standard cauliflower production. Curd size, with all wrapper leaves trimmed off, varies from ½ pound to 1½ pounds each in the hot weather lines. Considerable variation in yield occurs according to growing conditions. Variation in curd size is still found among individual plants in the same field. Heritable variation has been reduced by selection but not eliminated. A few unproductive plants may occur in the hot weather lines, but recent plantings have shown that 97 percent of the plants in a field of the improved hot weather lines will produce marketable curds if cultural conditions do not favor buttoning (production of undersized curds on small, stunted plants).

Hollow Stem. The hot weather cauliflower lines have been generally free of the hollow stem condition observed locally in plantings of Snowball cauliflower lines. A winter planting of Vaughn's Ideal Snowball at Poamoho Farm (1953) produced curds which were not only 3 weeks later than the Pua Kea lines but were unmarketable because the hollow stems in 90 percent of the

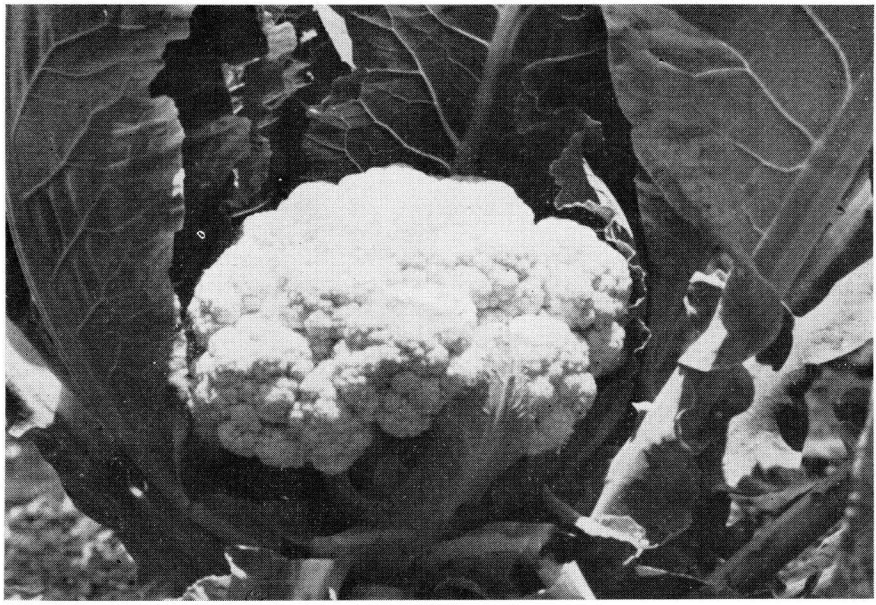

Figure 1. **A prime curd of the Pua Kea variety.**

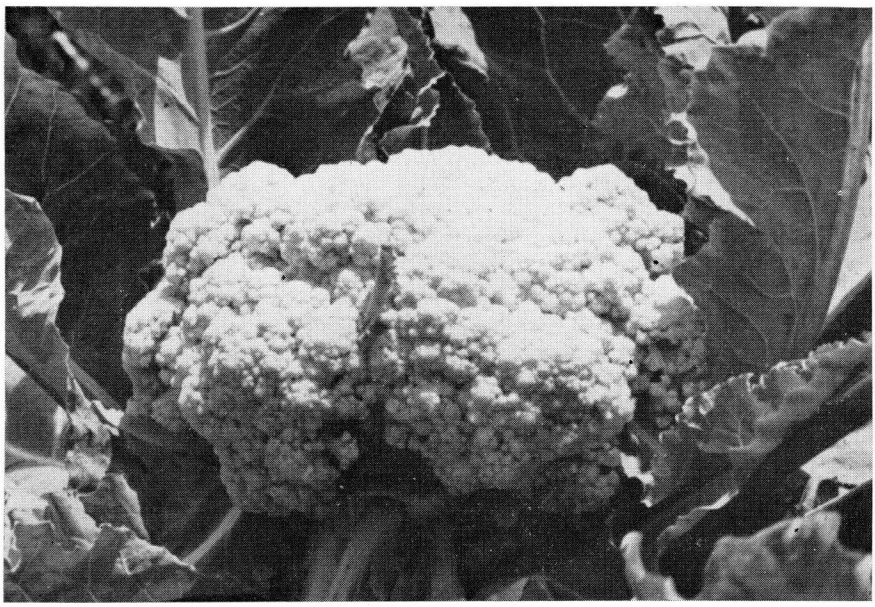

Figure 2. **A slightly overmature curd of the Pua Kea variety.**

plants were found to be infected with bacterial soft rot on the surfaces exposed to the hollow core. This condition extended up into the curds and rendered them unfit for market. Pua Kea cauliflower grown in the same field did not show this hollow stem condition.

Plant Habit. Since a light-colored curd is desired in cauliflower, upright wrapper leaves which will shade the curd most of the day are to be preferred. This character was present in only a few of the Indian cauliflower plants observed in the 1949 trials with this vegetable, and these plants had smaller curds than those with spreading leaves. Lines 14-10 and 19-1 have given fairly uniform performance in relation to this upright growth of the wrapper leaves and light-colored curds, but one of the more difficult objectives in the improvement of the hot weather cauliflower lines has been the combination of larger curd size with upright plant habit. The heaviest yielding plants were found in line 13, but these were all spreading in habit and had a darker yellow-cream curd. The Pua Kea variety, which was selected out of line 14-10, combines the upright growth of the wrapper leaves, light color of the curd, satsifactory yield, vigorous vegetative growth, and a reduced susceptibility to buttoning.

Buttoning. The production of very small, unmarketable curds on undersized plants which fail to make normal vegetative growth is termed buttoning. Experiments with the hot weather cauliflower lines have shown that this condition is more likely to occur when (1) seedling plants are slowed down in their growth and delayed in transplanting to the field, and (2) when the seed used is from an extremely early maturing line or from one somewhat lacking in vegetative vigor. In repeated plantings, line 14-10 showed much less tendency to button than other lines observed. With reasonably good cultural conditions, in the Pua Kea variety there should be no losses from buttoning.

Flowering and Seed Product. Unlike the standard Snowball cauliflower lines, hot weather or Indian types readily produce seed at low or medium elevations in Hawaii. However, a heavier seed set is generally secured during the winter months when more temperate conditions prevail. Honeybees or other insect pollinators in abundance aid seed set. Some single plants may produce 2 to 4 ounces of seed, but some will produce less. The flowers do not appear all at once, and, therefore, the maturity of the seed pods will be spread over several weeks' time. Birds often feed on the ripening seed, and seed-bearing plants may thus require protection from them. Covering the plant with a cheesecloth hood, after the young pods have set, is a good plan. Although the hot weather cauliflower lines take only 3 months or less to grow the curds for market, seed production requires 5 months or more.

Over-Maturity of Curds. Associated with this tendency of the hot weather cauliflower lines to produce seed readily in Hawaii, there is a rather sudden opening up of the curds a few days after reaching marketable size. This opening up of the curds by the plant in preparation for flowering will not interfere with the production of good, marketable curds, if the grower harvests every other day when the crop is mature. There is no bitterness nor off-flavor developing within the curds as the stems of the inflorescence start to elongate. With a little experience the grower can easily tell when a curd of the hot weather cauliflower has reached its maximum size and is about to open up. Harvesting should not be delayed beyond this point (see figs. 1 and 2). The individual plants do not all mature at the same date, but almost all can be harvested within a 2-week period. In the case of most of the hot weather lines grown at the

University of Hawaii, the harvest period occurred between 2½ and 3 months after the seed was planted. This was at low elevations, during warm weather.

Seed Viability. Germination tests with seeds of hot weather cauliflower lines kept under refrigeration (45-50°F.) for 1, 2, 3, and 4 years showed 63 percent strong germination in the 4-year-old seed and ranged up to 97 percent strong germination in the 1-year-old seed. Seed left in paper bags at room temperatures for 1 year at the University of Hawaii was 85 percent viable; but for longer storage, the seed should be kept under refrigeration and, preferably, in dry air.

CULTURAL EXPERIMENTS WITH HOT WEATHER CAULIFLOWER

Experimental plantings of hot weather cauliflower lines at Waimanalo Experimental Farm, at the University farm in lower Manoa Valley in Honolulu, and at Poamoho Farm (650-ft. elevation) have yielded some information on the cultural requirements of this crop which may be summarized as follows:

Applying manure or compost to hills, in addition to commercial fertilizer, produced significant increases in yields.

Starting seedlings in soil supplied with both organic and commercial fertilizer (the latter applied to young plants as a nutrient solution) produced rapid growth in the seedlings and eliminated losses from buttoning, when transplanting to the field was done at 3½ to 4 weeks of age.

Holding seedlings in the flats for 6 weeks before transplanting to the field significantly increased losses from buttoning.

Checking the growth of the young plants by allowing them to dry out soon after field setting increased losses from buttoning. While this crop can stand warm conditions, it needs ample irrigation during hot, dry weather.

Applying 10 pounds of boron per acre, mixed with commercial fertilizer, did not prevent the appearance of brown spotting on cauliflower curds at Waimanalo (summer 1952), but it did produce a 12 percent increase in yield. Free moisture on the curds has been associated with brown spotting, whereas cauliflower maturing during dry weather has been free of curd rotting. Growing the crop with furrow irrigation in dry, sunny districts is suggested in order to minimize loss from bacterial soft rot.

Insect control measures for hot weather cauliflower are similar to those needed on cabbage and broccoli, because the same insects attack all these crops. Control of the cabbage webworm and the imported cabbage worm (white butterfly) is usually needed. The cabbage aphid is sometimes present and can build up rapidly if unchecked.

Drenching of very young seedlings with several applications of a fungicide which will control damping-off injury to the stems of the small plants may be needed. Seeds should be treated with seed protectants before planting.

Field spacing of the cauliflower plants should be similar to that for broccoli or cabbage. This may be from 20 to 24 inches between plants in the row, with rows 30 inches apart. This spacing allows approximately 9,000 to 10,000 plants per acre.

Four ounces of seed per acre are required if the plants are transplanted to the field. Yields should average 3 tons or more per acre under favorable conditions. Harvesting with some of the wrapper leaves left on will help protect the curds from becoming soiled and will improve their market appearance.